Flexible drainage and subirrigation

A new module in iMOD 5.4

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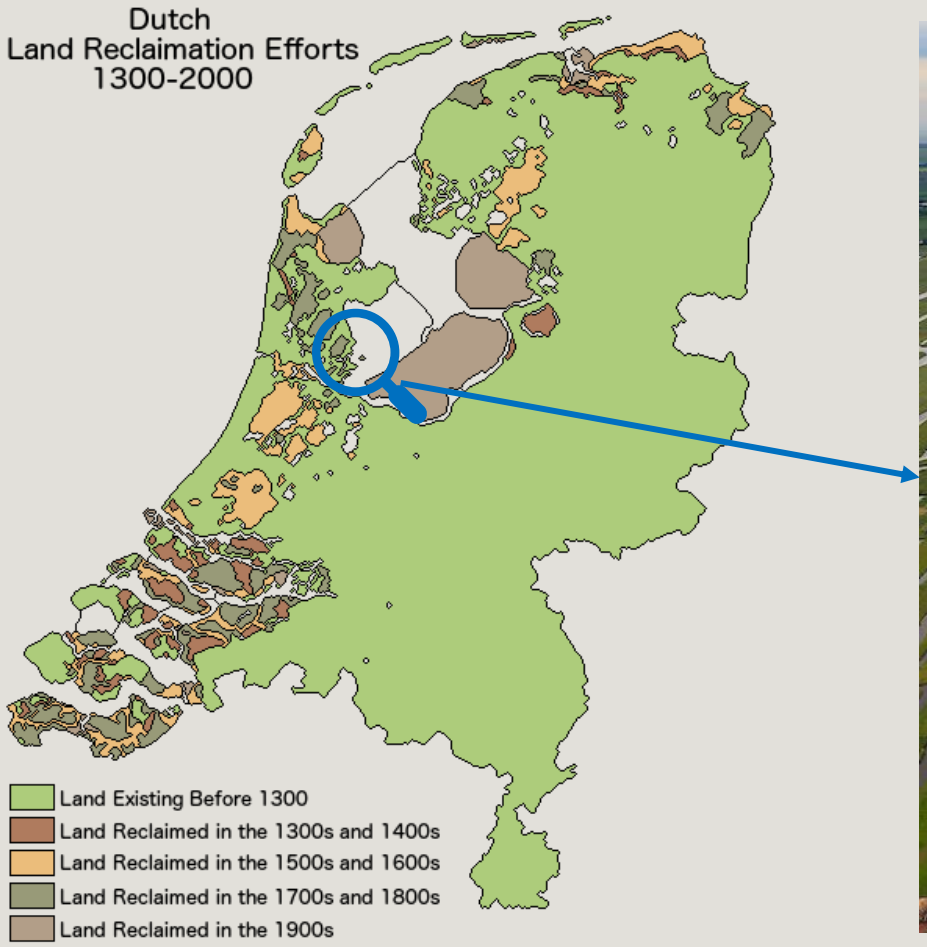
SWECO

VanWater

Date: 24-11-2022

“God created the earth, but the Dutch made the Netherlands”



brilliantmaps.com, 2017

Eilandspolder near Grootschermer, photo: Siebe Swart

"More severe and intensive **droughts**"

- Environment -

Droughts in Europe expected to worsen

By Rebecca Ochs - 24.04.2018

European Scientist, 2018

"Peat oxidation leads to **land subsidence** in Dutch polders"

NEWS ARTICLE | 22 August 2022 | Joint Research Centre

Summer drought keeps its grip on Europe

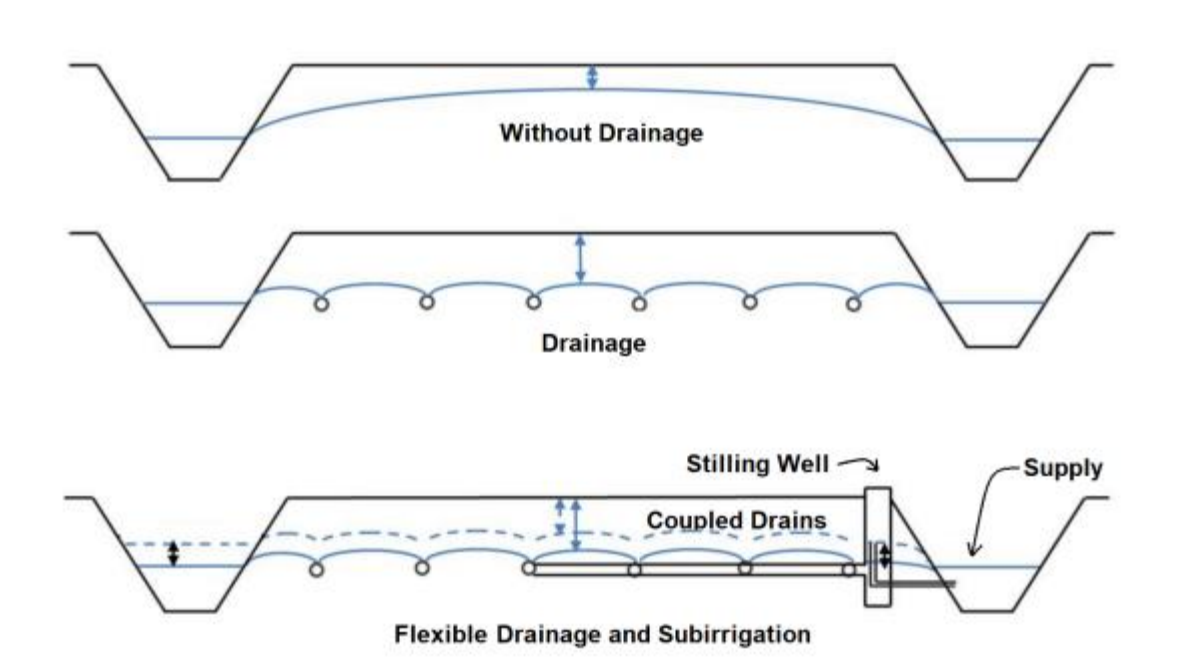
Exceptionally hot and dry weather conditions in much of Europe continued to substantially reduce yield outlooks for the EU's summer crops.

Summer crops, such as maize, are in poor condition in the regions affected by drought.
© B. Baruth

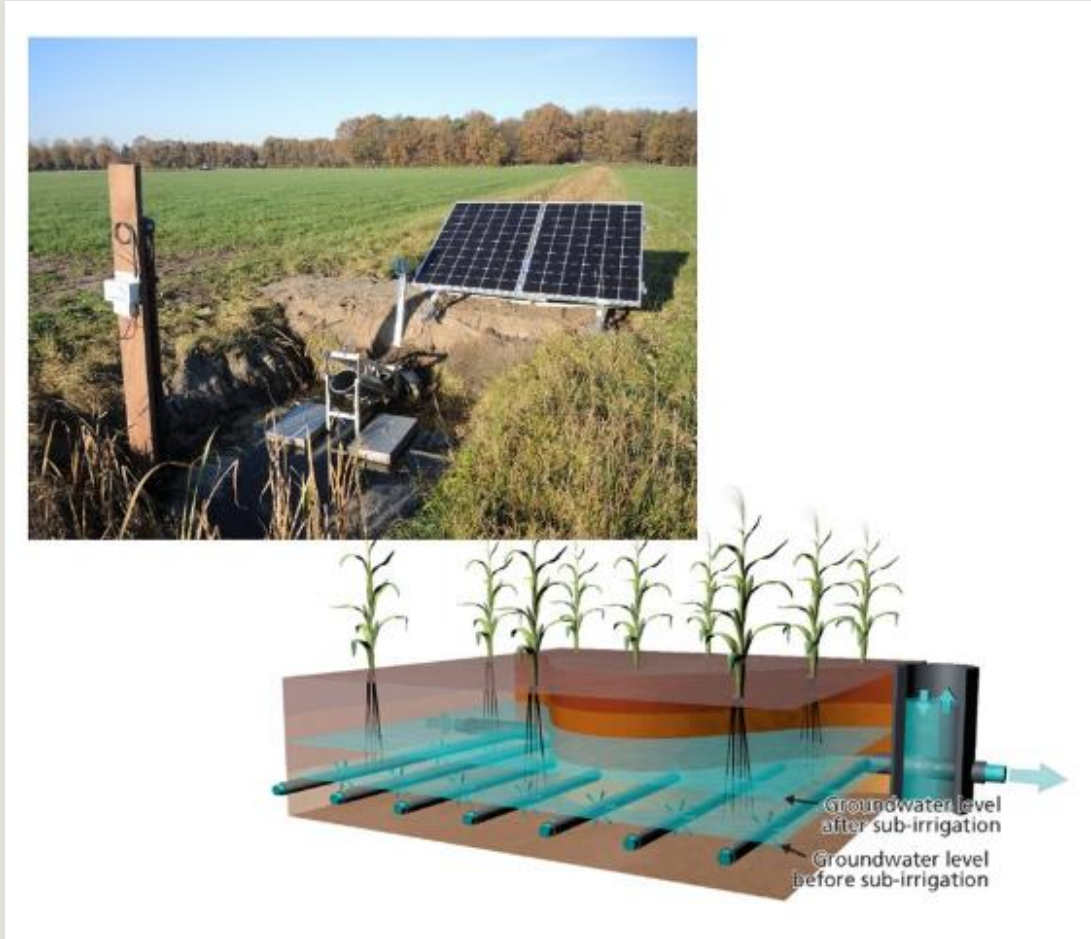
Joint Research Centre, 2022

Flexible drainage can be part of the solution

- Minimalize drainage
  - Increasing groundwater levels
  - Creating a groundwater buffer
- Maintaining control



Concept of a flexible drainage subirrigation system (iMOD user manual V5.4)



Flexible drainage subirrigation system (Narain-Ford et al., 2020)

Flexible drainage and subirrigation in iMOD 5.4

- Included in the “Unsaturated zone package” (MetaSWAP)

Input files:

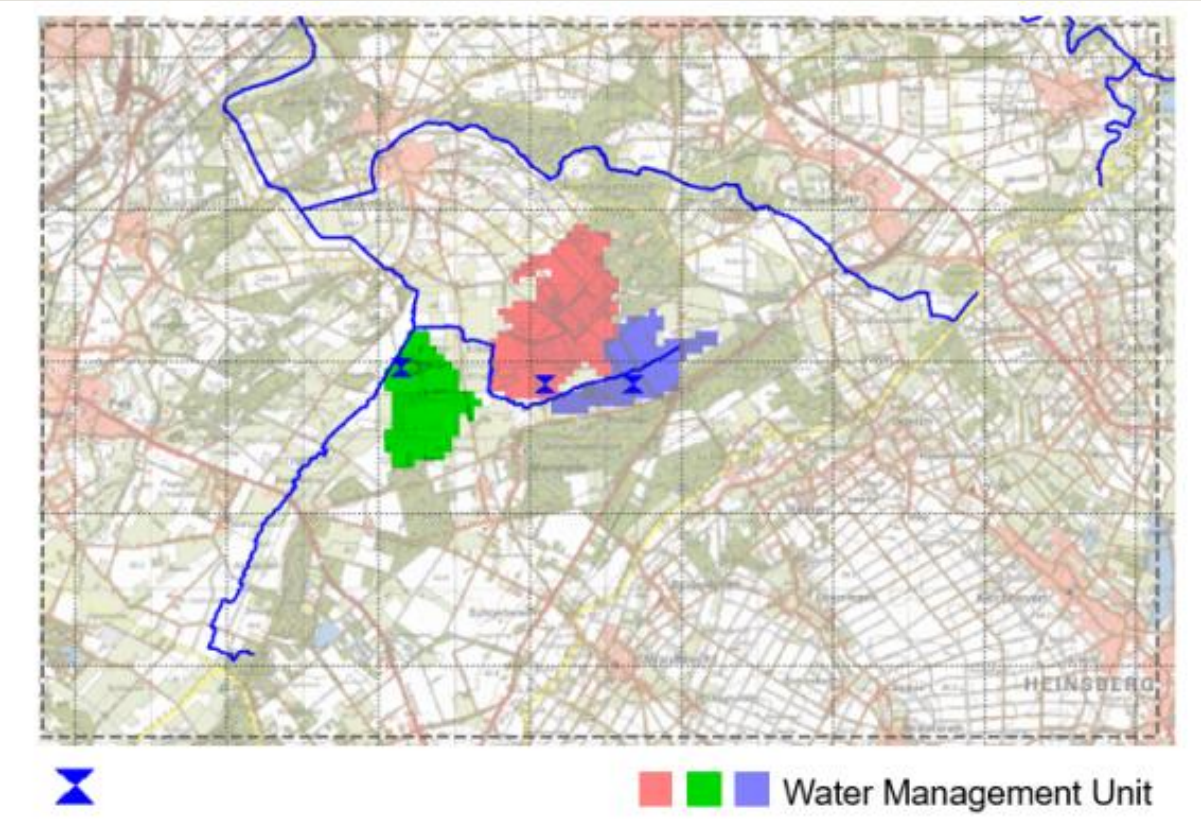
IDF-files:

- grid defining ***flexible drainage plots*** (Water Management Units – WMU)
- grid defining ***drainage base*** per WMU
- grid defining ***drainage resistance*** per WMU

IPF-file:

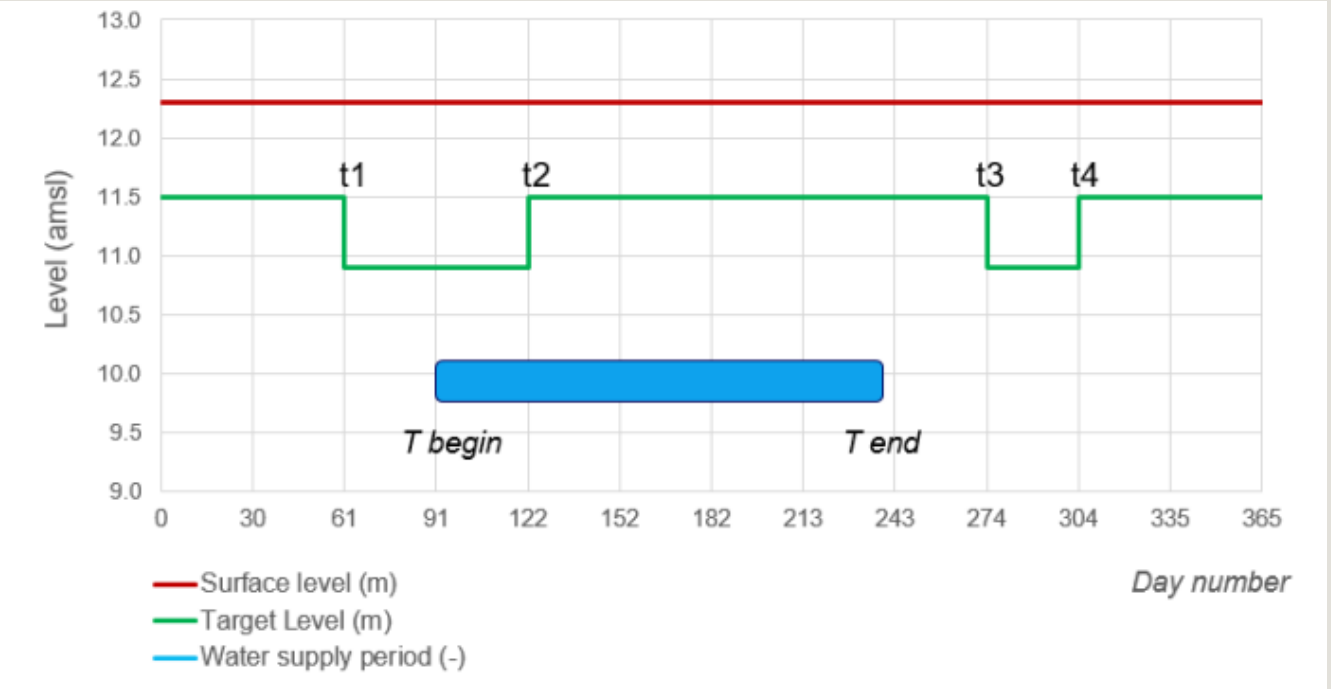
Point file with:

- X and Y of steering location
- supply capacity for subirrigation
- low target level
- high target level
- X, Y and Z of groundwater extraction location
  NoData (-9999) = surface water extraction



Example of Water Management Units

Flexible drainage and subirrigation in iMOD 5.4

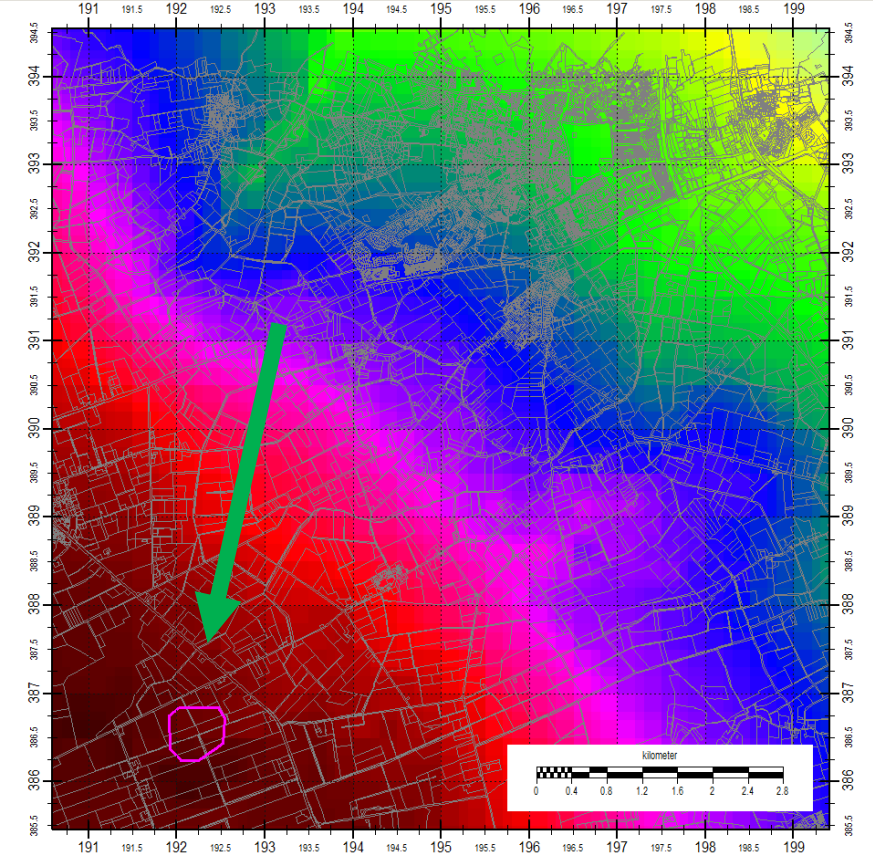


INP-file:

Flexdsub_svat.inp with **temporal parameters** and **management settings** per land use type

- 4 dates for high to low target level switch
- 2 dates defining the water supply period (=0 for no supply/subirrigation)
- Critical values for triggering target level drop:
  - Critical groundwater level
  - Critical relative transpiration level for oxygen stress

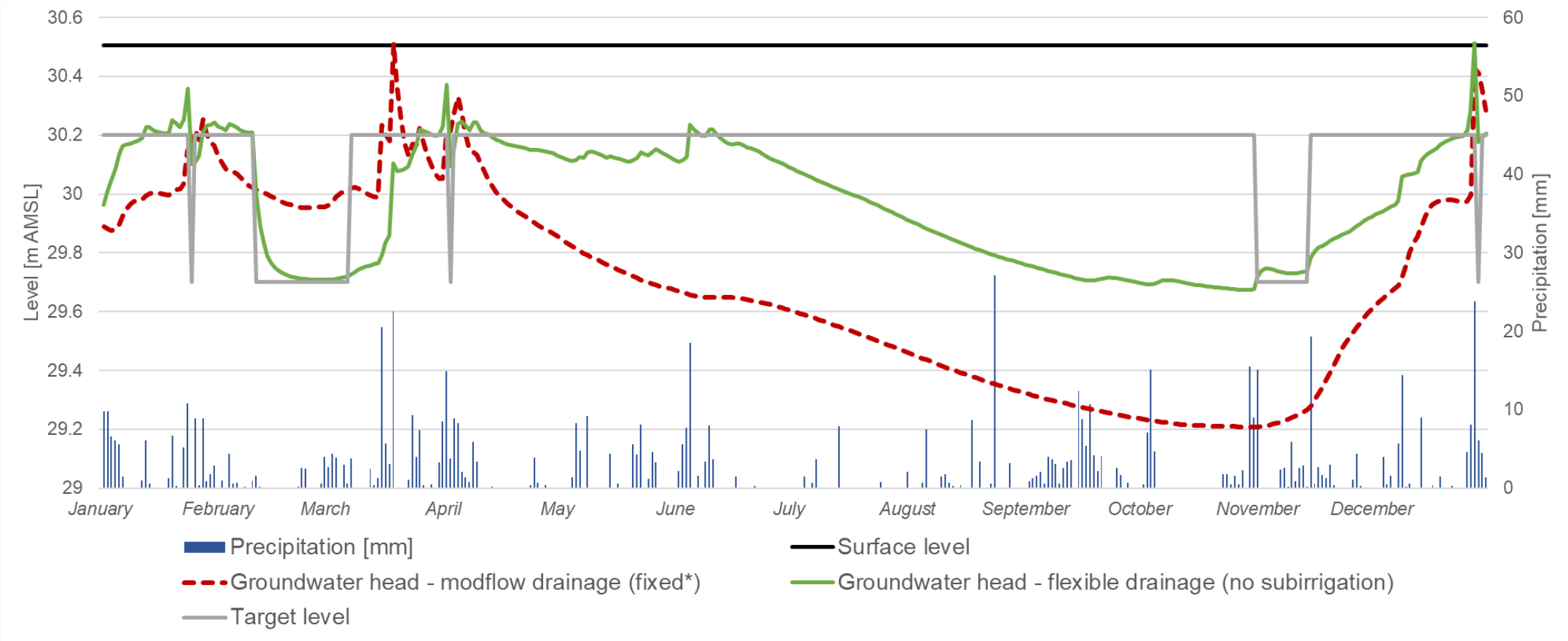
Flexible drainage – subirrigation example



- Some parameters:
  - Drainage base: 1 m BGL
  - Drainage/infiltration resistance: 25 days
  - Low target level: 0.8 m BGL
  - High target level: 0.3 m BGL
  - Target level drops 9-feb & 29-okt
  - Supply: 1-apr → 30-sept
  - Groundwater extraction 30 m BGL

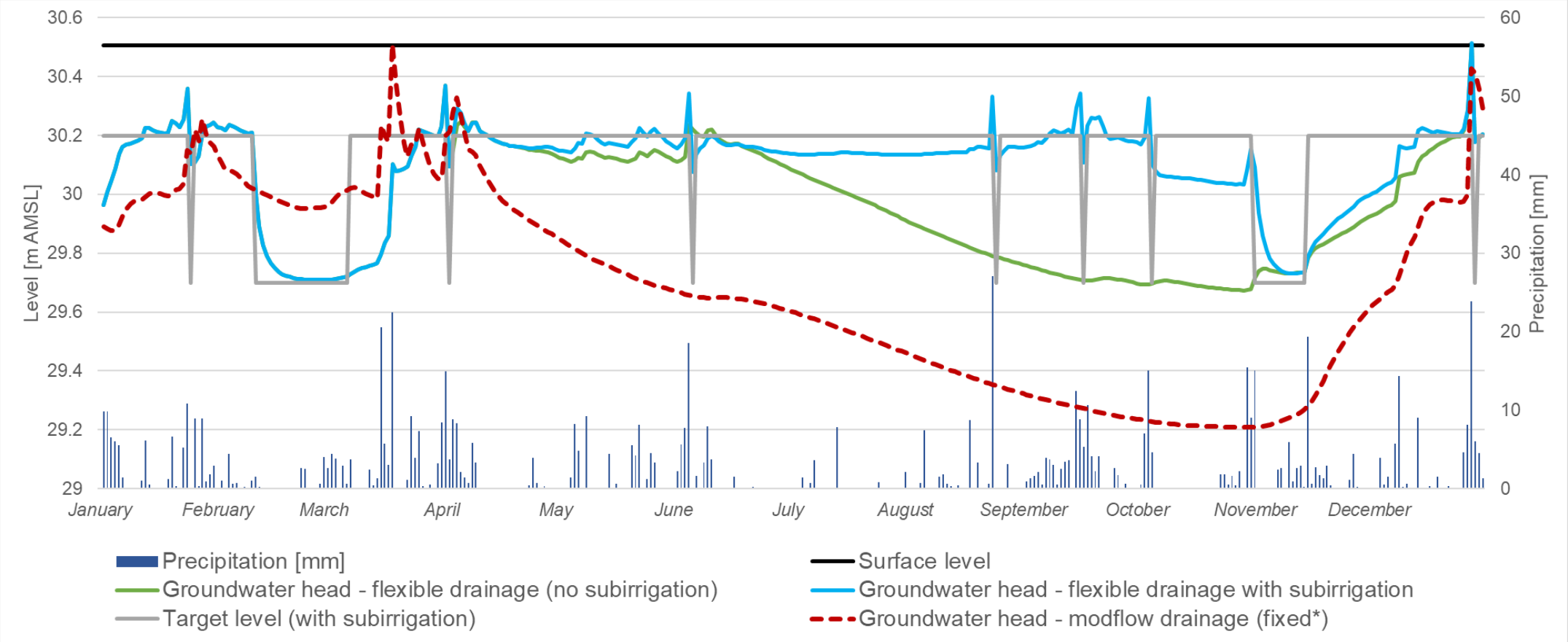
- Location favorable for flexible drainage with subirrigation

Results - conventional drainage versus flexible drainage



** Fixed drainage level at 0,5 m below surface level / +29,9 m AMSL*

Results - flexible drainage **with subirrigation**



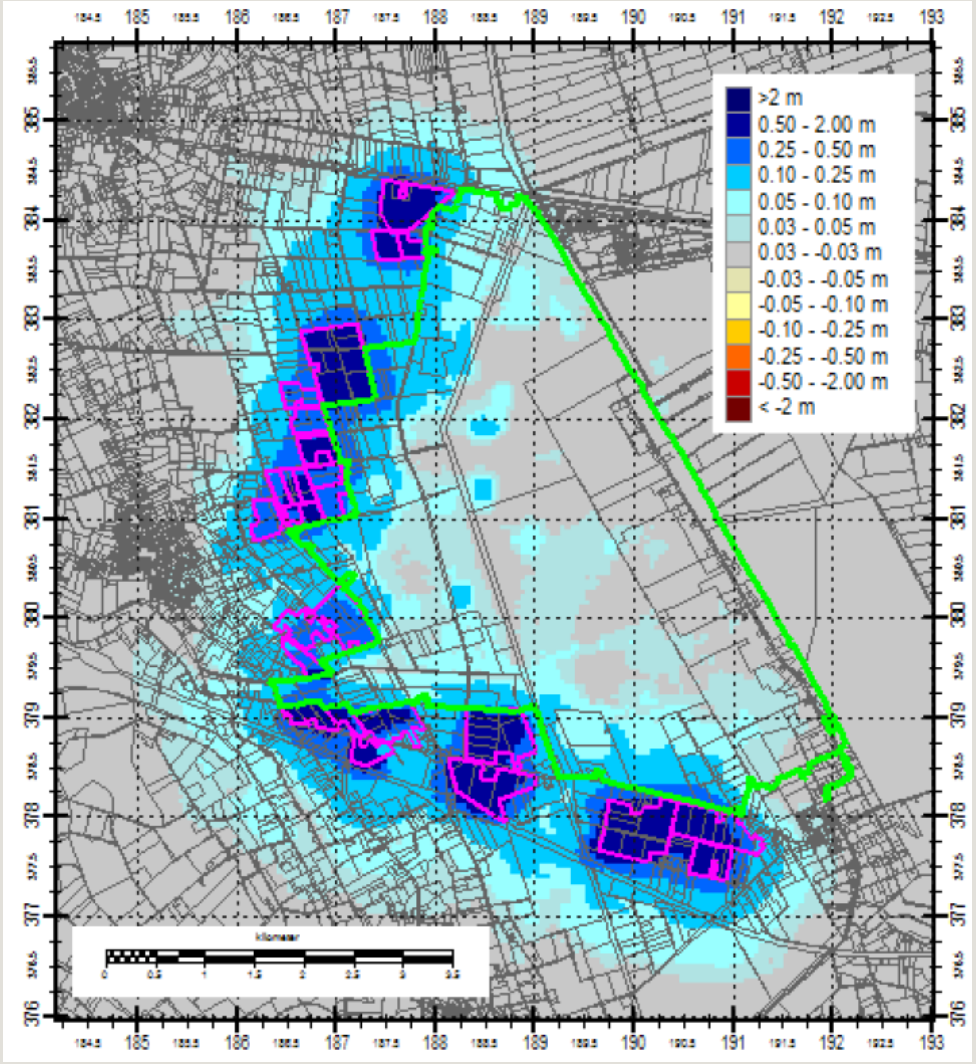
Large scale application of subirrigation

Potentially increases groundwater levels on a regional scale

- Creating a buffer against drought
- Reduces peat oxidation

Is large scale subirrigation feasible?

- ❑ Can supply meet demand?
- ❑ What if all plots drain at once?
- ❑ Extraction from groundwater or surface water?
- ❑ Can the conserved or infiltrated water be retained in the subsurface?



Potential effects of large-scale subirrigation (H_2O, 2021)

Final notes

- ✓ Flexible drainage might be one of the solutions for mitigating drought and peat oxidation
- ✓ Flexible drainage with subirrigation can be simulated with iMOD 5.4
- ✓ WOFOST-coupling crop-soil moisture interactions
- ✓ Module can also be used for modelling “surface water controlled drainage”

- ❑ Coupling with a dynamic surface water module is in development
  - currently surface water supply is capacity limited only

Thank you for attending!

Any questions?

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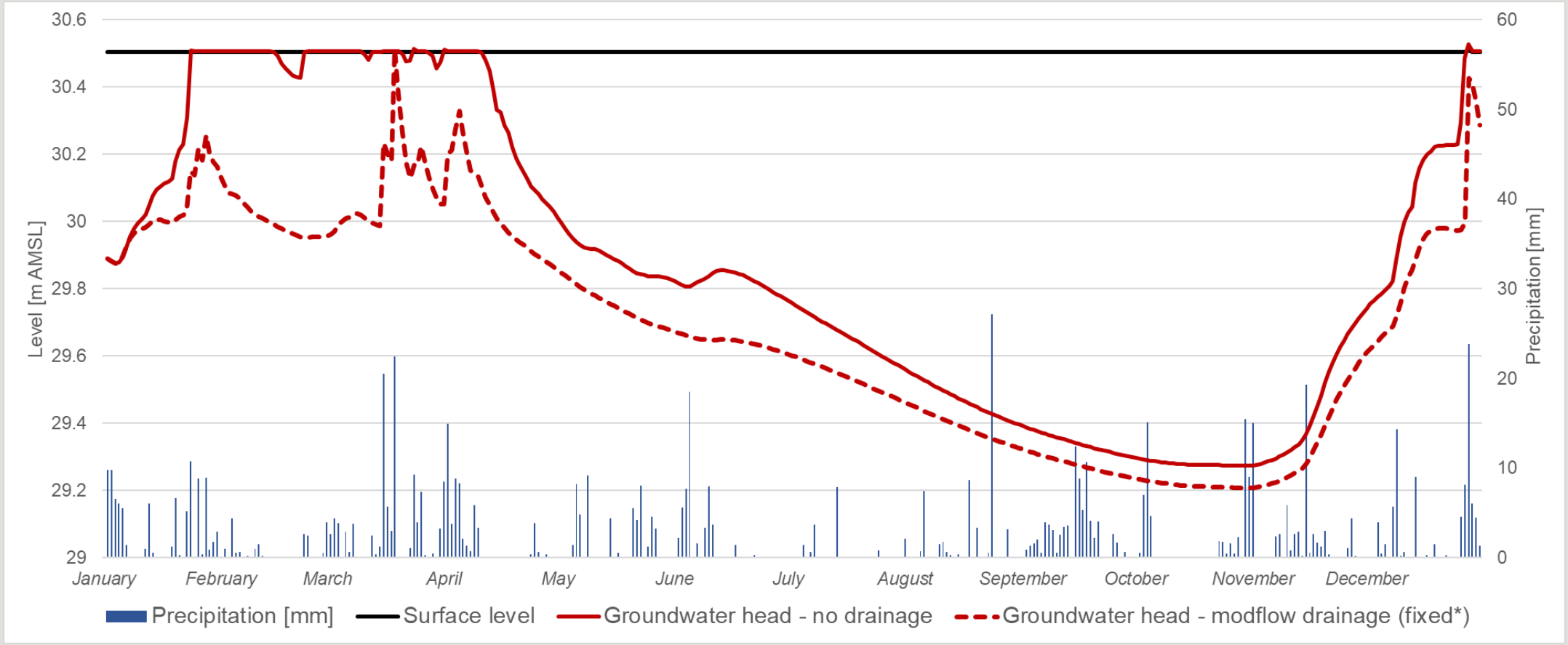
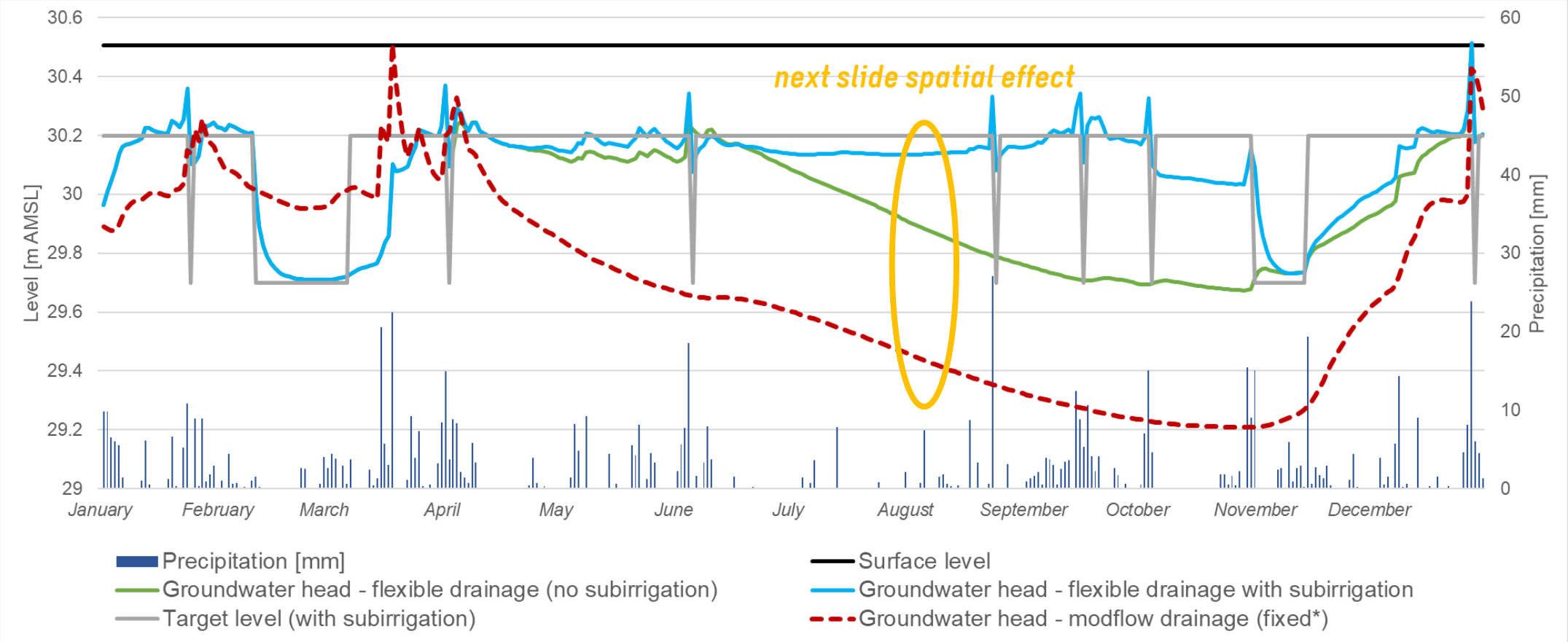
More information?
See iMOD 5.4 user manual
section 11.1.1 and Appendix A

Results - no drainage versus conventional drainage

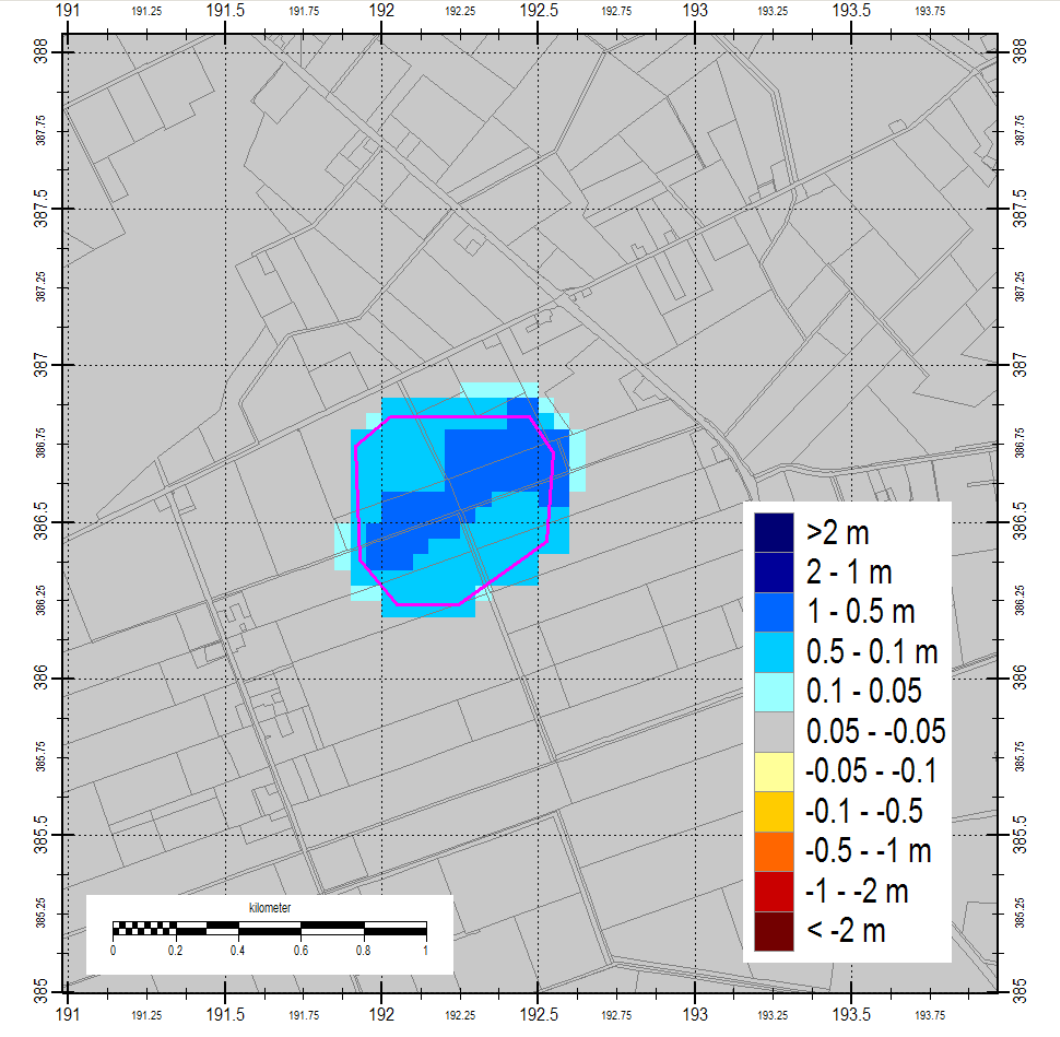


** Fixed drainage level at 0,5 m below surface level / +29,9 m AMSL*

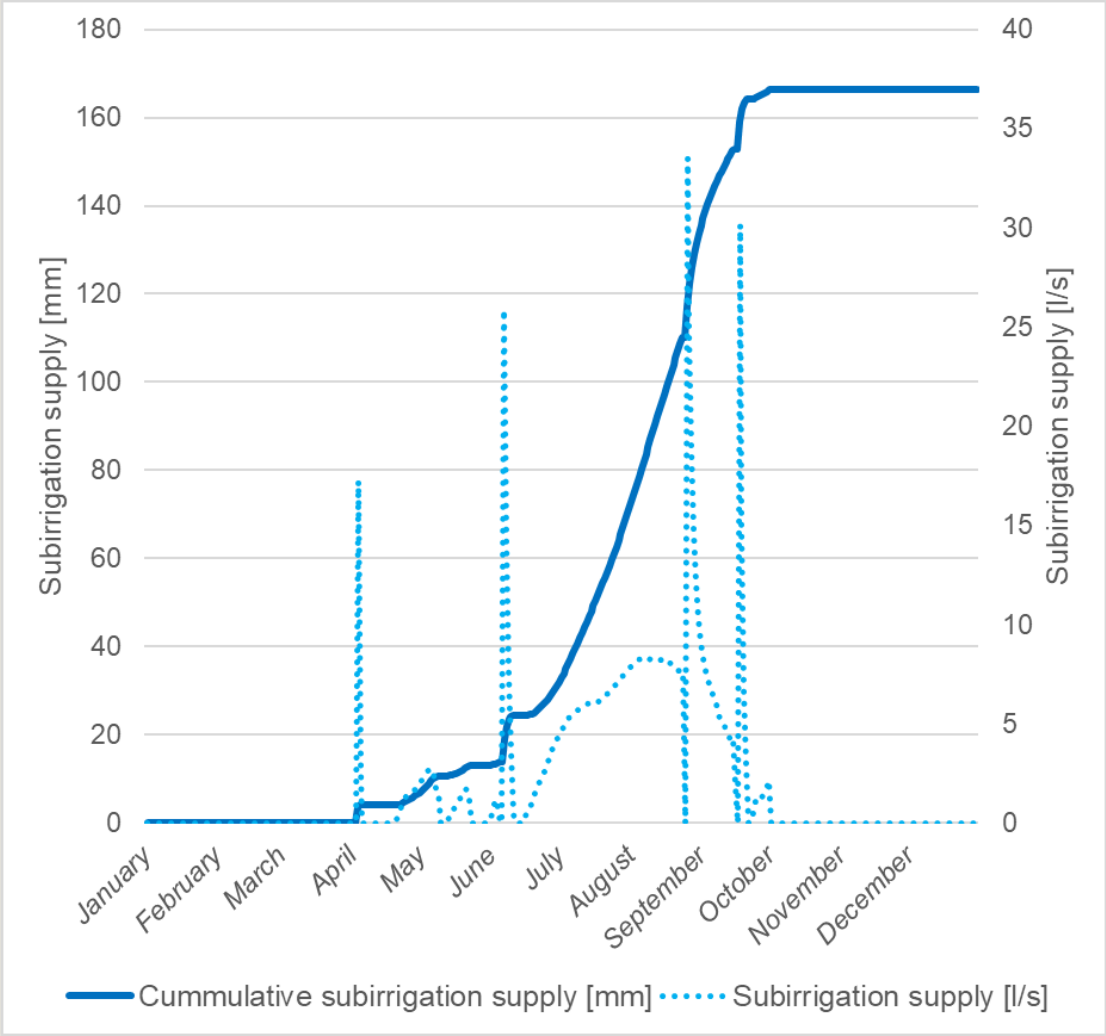
Results - flexible drainage **with subirrigation**



Results - spatial effects of subirrigation

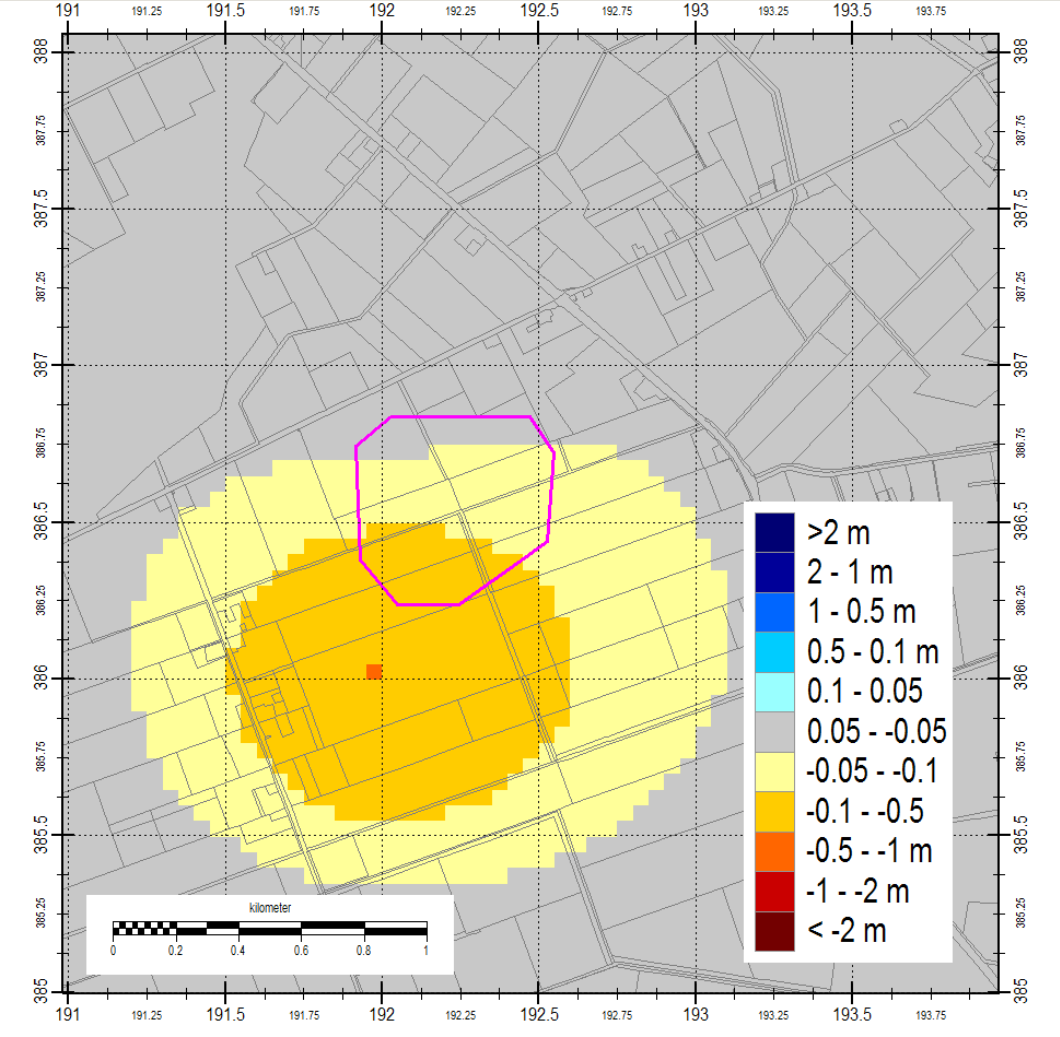


*Effect of subirrigation on groundwater head on 1st of August; Water Management Unit in **purple***

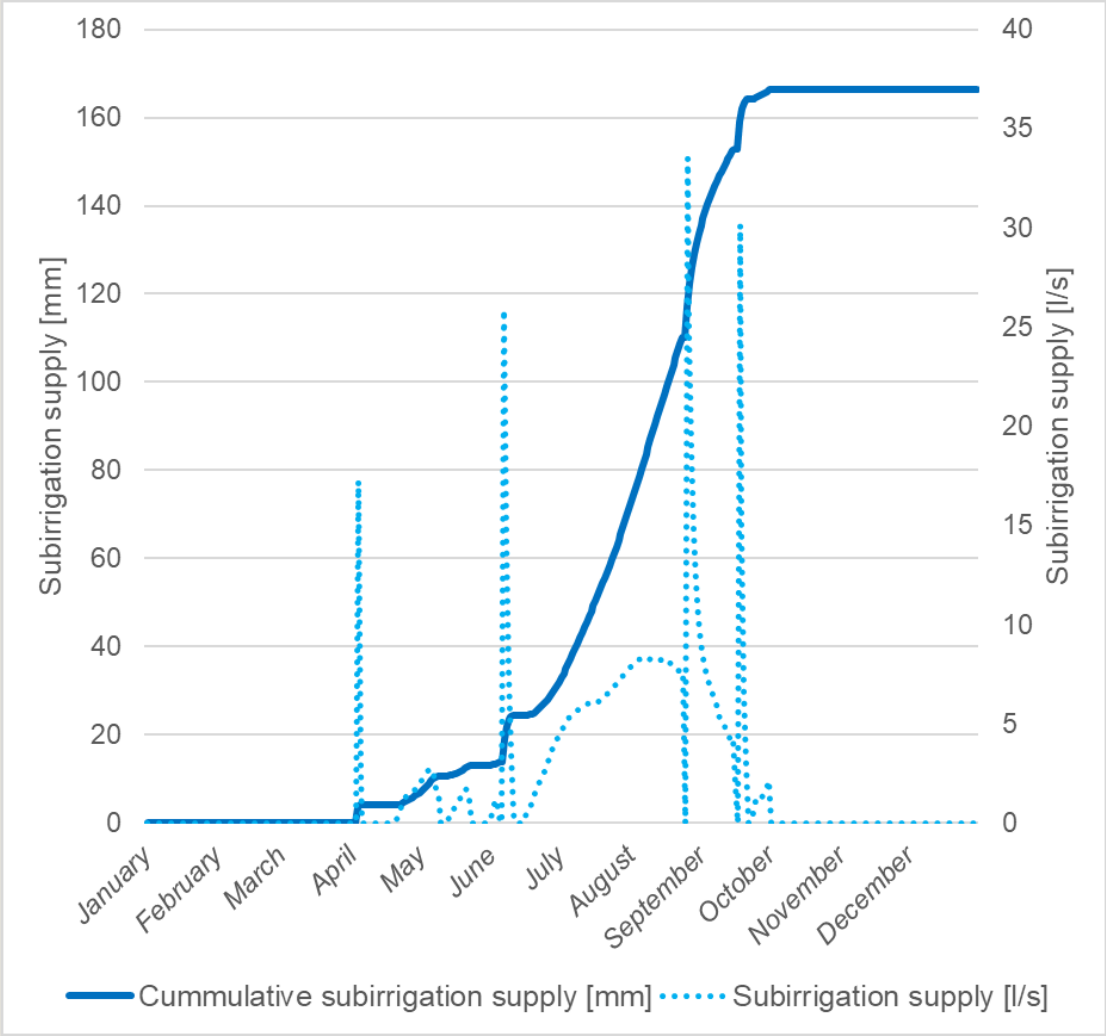


Subirrigation water supply

Results - spatial effects of subirrigation



*Effect of groundwater extraction for subirrigation on 1st of August; Water Management Unit in **purple***



Subirrigation water supply

Input

```
1
9
X
Y
qcapsubk
lvtarmn
lvtarmx
x_gw_abstraction
y_gw_abstraction
depth_nap_gw_abstraction
id
0,TXT
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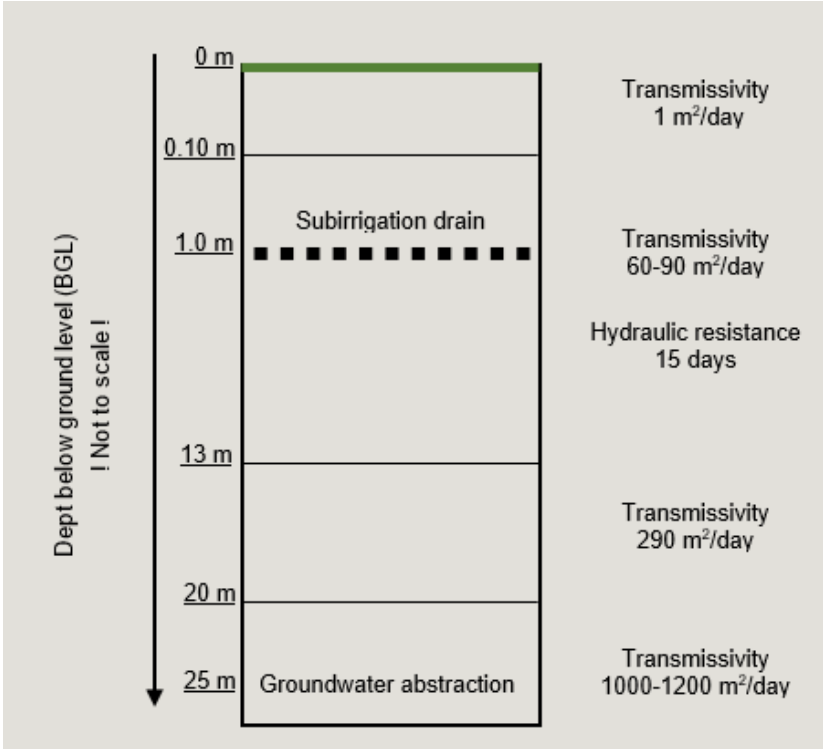
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9	9	40.00	65.00	303.00	317.00	91.00	273.00	10.00	0	0	20
10	10	40.00	65.00	303.00	317.00	91.00	273.00	10.00	0	0	20
11	11	40.00	65.00	303.00	317.00	91.00	273.00	10.00	0	0	20
12	12	40.00	65.00	303.00	317.00	91.00	273.00	10.00	0	0	20
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18	18	40.00	65.00	303.00	317.00	91.00	273.00	10.00	0	0	20
19	19	40.00	65.00	303.00	317.00	91.00	273.00	10.00	0	0	20